User's Manual

SPK-GPS-Y1020A/GPS-Y1020P

Mountable GPS Receiver Module

Version 1.00

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1 Introduction

1.1 Overview

The S P K GPS-Y1020A/GPS-Y1020P mountable GPS receiver module is a single side Global Position System Receiver. Innovative packaging technologies enable the high integration of GPS receiver in a small module measuring just 25.4mm x 25.4 mm and allowing the straightforward integration in particularly small end products and the opportunities in new application fields.

The GPS-Y1020A/GPS-Y1020P shows the mini size, high performance, low power consumption and is suitable for handheld applications. It is also the first application of such small single side GPS unit based on the newest SONY architecture in the world.

1.2 Features

The GPS-Y1020A/GPS-Y1020P provides the features that make the host easy for integration.

- ✓ Full implementation of SONY CXD2951 architecture.
- ✓ 12 parallel satellite-tracking channels for fast acquisition and reacquisition
- ✓ Provide superior navigation performance in urban canyon and foliage environments
- ✓ Ultra small, single side and low power consumption
- ✓ Support NMEA0183 v3.01 data protocol or SONY binary code
- ✓ Full navigation accuracy provided by Standard Positioning Service (SPS).
- ✓ Integrated powerful CPU, base band and RF hardware in an SOC (System On Chip) design reduces the space and power consumption in state of the art.
- ✓ High performance firmware drives an excellent positioning speed.
- ✓ No any initialization setup is required while start to use.
- ✓ Fully shielded.
- ✓ Postage stamp type package.
- ✓ No RF connector, RF input via pin.
- ✓ Battery supply pin for real time clock and backup memory.
- ✓ Power saving support.

1.3 Technical Specifications

Features	Specifications
GPS receiver:	L1, C/A code, 12 channels
Tracking sensitivity:	–152dBm (average) or better
Acquisition sensitivity:	–139dBm (average) or better
TTFF (Time to First Fix):	Cold Start: 50s (average) / 60s (95% possibility) Warm Start: 35s (average) / 40s (95% possibility) Hot Start: 2s (minimum) / 6s (95% possibility)
Positioning accuracy:	Standard Positioning Service (SPS), WAAS (optional) 2DRMS: approx. 5m
Time accuracy:	1μs or less precision
Measurement data output:	Update time: 1 second NMEA output protocol: V.3.01 Baud rate: 4800, 9600, 19200, 38400 bps (8-N-1) Datum: WGS-84 Type: GGA, GSA, GSV, RMC, VTG, ZDA, GLL, SONY Binary
Power consumption:	39mA (average)
Power supply:	3.3V
Antenna type:	GPS-Y1020A: Active antenna GPS-Y1020P: Passive antenna
Dimension:	single side 25.4(W) x 25.4(L) x 3.6(H) mm
Operating temperature:	-40℃ ~ +85℃
Storage temperature:	-55℃ ~ +100℃

1.4 Serial Communication Interface

1. Serial communication channel and user selectable baud rate among 4800, 9600, 19200, and 38400 (default 4800) bps.

2. NMEA 0183 Version 3.01 ASCII output. (GGA, GLL, GSA, GSV, RMC, VTG, ZDA)

1.5 Initialization

As soon as the initial self-test is complete, the GPS-Y1020A/GPS-Y1020P engine board begins the process of satellite acquisition and tracking automatically. After a position fix has been calculated, information about valid position, velocity and time is transmitted over the output channel.

The GPS-Y1020A/GPS-Y1020P engine board utilizes initial data, such as last stored position, date, time and satellite orbital data, to achieve maximum acquisition performance. If the initial data is inaccurate, or the orbital data is obsolete, it may take more time to achieve a position fix process. The GPS-Y1020A/GPS-Y1020P engine board auto-locate feature is capable of automatically determining the position fixing without intervention from the host system.

1.6 Navigation

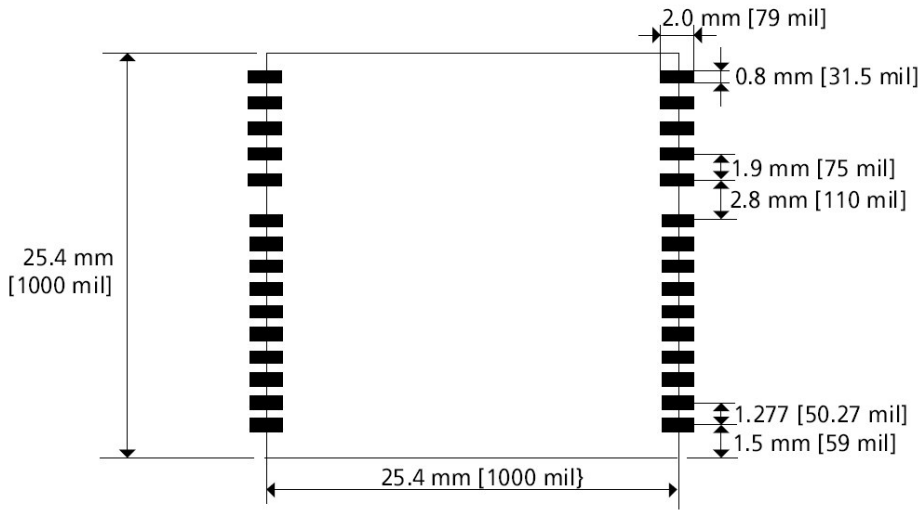
After the position fixing process is complete, the GPS-Y1020A/GPS-Y1020P engine board sends valid navigation information over output channels. These data include:

1. Latitude/longitude/altitude
2. Velocity
3. Date/time
4. Error estimates
5. Satellite and receiver status

2 Hardware Interface

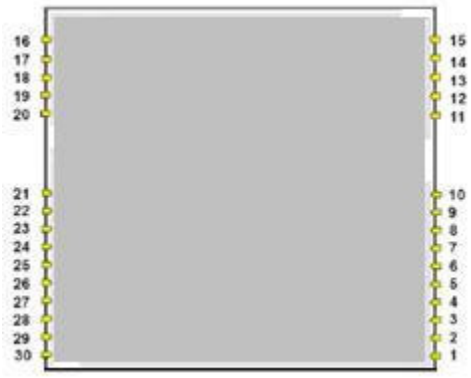
2.1 PCB Dimension and Layout Descriptions

The 30-pin stamp hole mechanical interface is the same as JP7 from Falcom® and TIM from u-blox®.



2.2 30-pin I/O Interface

2.2.1 Electrical interface



The definitions of 30-pin interface connector:

Pin No	Name	Pin Description	I/O	Note
1	VCC	Supply voltage	I	3.3V DC
2	GND	Digital ground	I	

3	NC			
4	RXD	Serial data input	I	This input is used to receive binary messages from application software.
5	TXD	Serial data output	O	This output provides NMEA navigation data and binary messages to user's application program.
6	NC			
7	NC			
8	STATUS	Indicates fix status of GPS	O	The output is flashing when it is not fixed. The frequency becomes higher as it is closer to fix. It is always ON as it is fixed.
9	RF_ON	Indicates power state of RF part	O	High if VCC_RF is on
10	GND	Digital ground	I	
11	RF_GND	Analog ground	I	
12	RF_GND	Analog ground	I	
13	RF_GND	Analog ground	I	
14	RF_GND	Analog ground	I	
15	RF_GND / PWR_SW	Analog ground (default) / Power switch (customized by order)	I	Enter power saving mode if high
16	RF_GND	Analog ground	I	
17	RF_IN	GPS signal from antenna	I	50 Ohms @ 1.575GHz.
18	RF_GND	Analog ground	I	
19	V_ANT	Power supply for active antenna	I	
20	VCC_RF	Voltage supply of RF section	O	Power supply for an active antenna
21	V_BAT	Backup voltage supply for RTC	I	3.3V DC Battery backup input for saving positioning data.
22	RESET_N	Active low reset input	I	This pin provides an active-low reset input to the engine board. Activation of this pin will reset and start acquisition process. It may be left open if not utilized. To reset GPS-1020, the low period of this input signal should be at least 100ms.
23	NC			
24	NC			
25	NC			
26	NC			
27	NC			
28	NC			
29	1PPS	One pulse per second	O	This pin provides One-Pulse-Per-Second output from the engine board, which is synchronized to GPS time.
30	GND	Digital ground	I	

Notes:

1. The VCC input voltage should be well regulated. Noise on it will degrade the performance of this product.
2. Pin 15 is by default RF_GND. For cases that users of GPS-1020 want to enter power saving mode and are not able to cut off VCC, set this pin (PWR_SW) high, then it will cut off VCC inside GPS-1020. However, this function needs to be specially customized made and thus needs to order separately. By default, this is an analog ground pin.
3. In addition to the internally supported power source (VCC_RF; 3.3V) for external antenna, there could be other voltage options. E.g. To use an active antenna of

4V/5V/12V, voltages of 4V/5V/12V needs to be connected to V_ANT respectively. Please note that noise on the antenna bias voltage will degrade the GPS performance of GPS-Y1020. Do not connect VCC_RF to this pin if external voltage input is used.

4. Connect pin VCC_RF to V_ANT if there is no external voltage input for external antenna. It supports active antenna of 3.3V.

2.2.2 Mechanical interface

GPS-Y1020A/GPS-Y1020P engine board supports a 30-pin reflow solderable interface, which allows automatic pick-and-place assembly.

2.3 6-pin Connector Interface

2.3.1 Electrical interface

There is a 6-pin interface mainly for engineering test purpose. It could also be used for production test or as user interface. To connect it to a 6-pin PS2 interface. It is defined as following:

Pin	Name	I/O	Description	Level	PS2 Pin
1	VCC	I	Power source	3.3V DC	1
2	VBAT	I	Battery input	Max. 3.3V DC	2
3	TXD	O	Serial data output	3.3V	3
4	GND	I	Ground		4
5	RXD	I	Serial data input	3.3V	5
6	STATUS	O	GPS fix status	3.3V	6

Please note that the UART (TXD, RXD) level is 3.3V not RS232. To communicate via RS232, an UART to RS232 data cable should be used.

2.3.2 Mechanical interface

These pins could be connected to outside application environment via either soldering or male connector of pitch 2.54mm. Female connector of pitch 2.54 mm is adopted for this interface.

When in mass production, the male connector is not mounted on board. It is mounted

only at engineering test phase. It can be mounted by customer's order.

2.4 Antenna

GPS-Y1020 supports both passive and active antennas and they are connected to the RF_IN directly. The two models are different and should be specified while order.

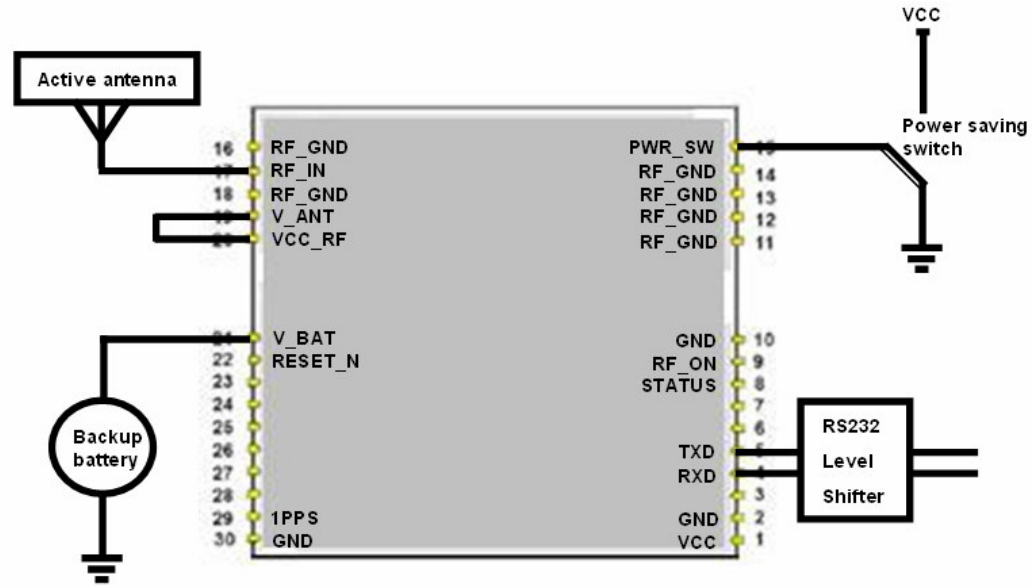
1. GPS-Y1020A: Active antenna

   i. The external active antenna could be powered by GPS-Y1020A or by external power input. This option is especially mandatory as active antenna of different voltage bias is used. E.g. the built-in voltage for active antenna is 3.3V. User may prefer active antenna of different voltage biases such as 4V, 5V, 12V etc.

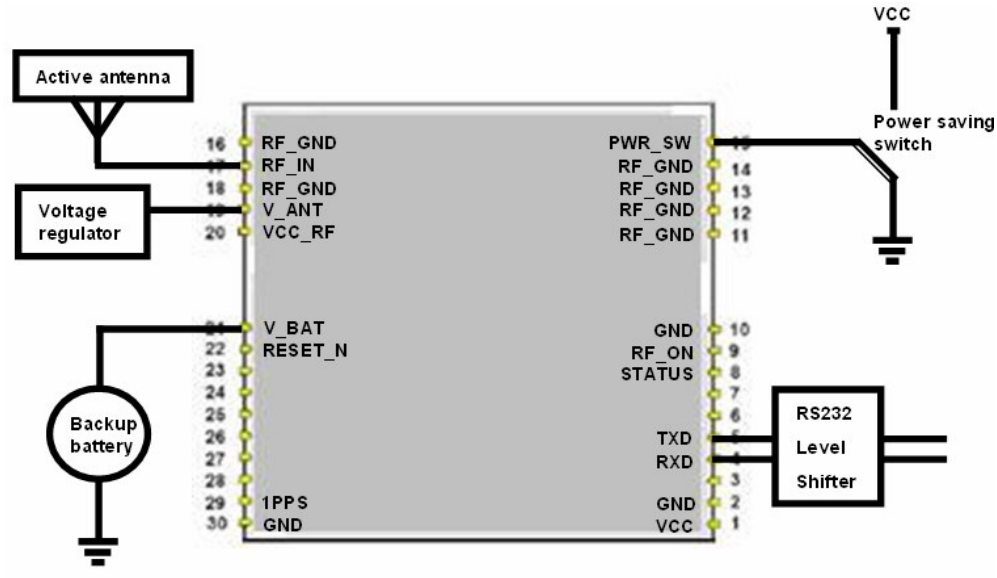
   ii. Connect the external power source to pin V_ANT if external active antenna power source is preferred. E.g. connect the 4V/5V/12V voltage bias to V_ANT for active antenna of 4V/5V/12V respectively.

   iii. Pin VCC_RF is connected to V_ANT externally if the built-in power source (3.3V) for external antenna is preferred.

   iv. External active antenna powered by GPS-Y1020A (3.3V)



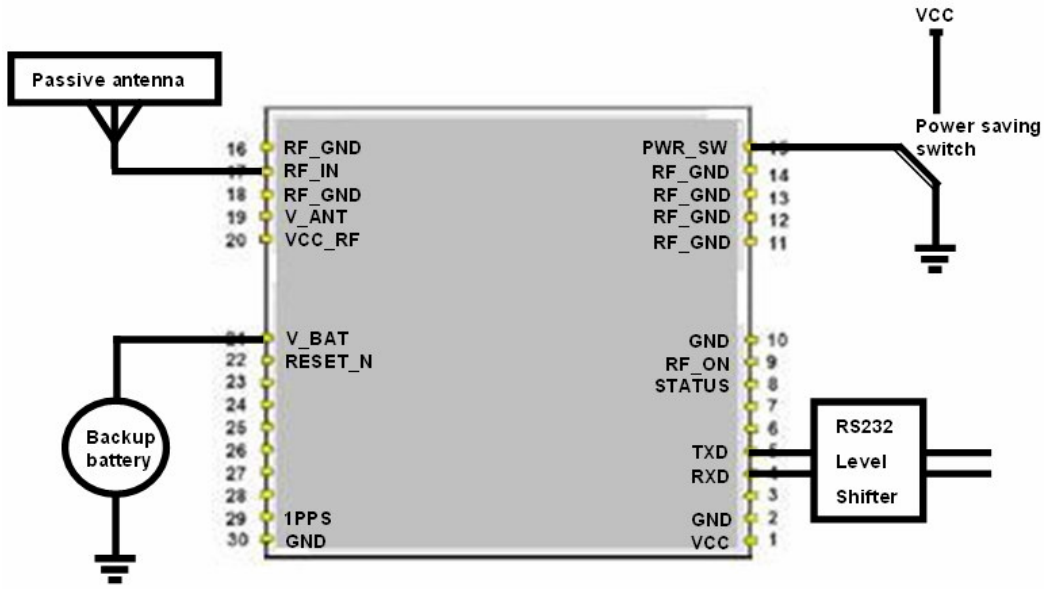
v. External active antenna powered by external power input. (not 3.3V)



2. GPS-Y1020P: Passive antenna

i. GPS-Y1020P does not have on-board passive antenna. However, it allows passive antenna to connect to it directly without extra LNA/SAW.

ii. GPS-Y1020P with passive antenna.



2.5 Power saving mode

Default:

The power saving mode is achieved by cut off the VCC input. It consumes only 7.7uA (Ta = 25℃). Please note that V_BAT should be connected for better TTFF.

Customized made:

The other way to enter power saving mode for cases that users are not able to cut off VCC is to use PWR_SW pin. This pin will enable power saving. For cases that users of GPS-Y1020 want to enter power saving mode and are not able to cut off VCC, set PWR_SW pin high, then it will cut off VCC inside GPS-Y1020. The backup power is always requested to support power of RTC and GPS memory while in power saving mode. There is no on-board backup battery. The backup power is supported via pin V_BAT of the 30-pin stamp-hole interface.

3 Software Interface

3.1 NMEA Transmitted Messages

The GPS-Y1020 engine board interface protocol is based on the National Marine Electronics Association's NMEA-0183 interface specification, which is defined in NMEA 0183, Version 3.01. This engine board doesn't support the Radio Technical Commission for Maritime Services (RTCM) for Differential Navstar GPS Services.

The default communication parameters for NMEA output are 4800 baud, 8 data bits, 1 stop bit, and no parity.

The NMEA-0183 Output Messages are shown as below:

NMEA Record	Descriptions
GPGGA	Global positioning system fixed data
GPGLL	Geographic position- latitude/longitude
GPGSA	GNSS DOP and active satellites
GPGSV	GNSS satellites in view
GPRMC	Recommended minimum specific GNSS data
GPVTG	Course over ground and ground speed
GPZDA	Time & Date

GPS-Y1020 outputs messages in NMEA0183 (Ver. 3.01) format. GPS-Y1020 can output 8 different types of sentence: GPGGA, GPGLL, GPGSA, GPGSV, GPRMC, GPVTG, GPZDA and PSGSA. If 9600bps or 19200bps or 38400bps baud rate is set for port setting, it outputs 6 types of sentence: GPGGA, GPGSA, GPGSV, GPVTG, GPZDA, and PSGSA as default. Moreover, if 4800bps baud rate is set, it outputs 4 types of sentences: GPGGA, GPGSA, GPGSV, and GPRMC as default.

Single message example

$GPGGA,105512,3536.5981,N,13944.8914,E,1,05,01.7,00100.7,M,039.2,M,,*44

$GPGSA,A,3,08,11,20,28,31,,,,,,,,03.2,01.7,02.7*02

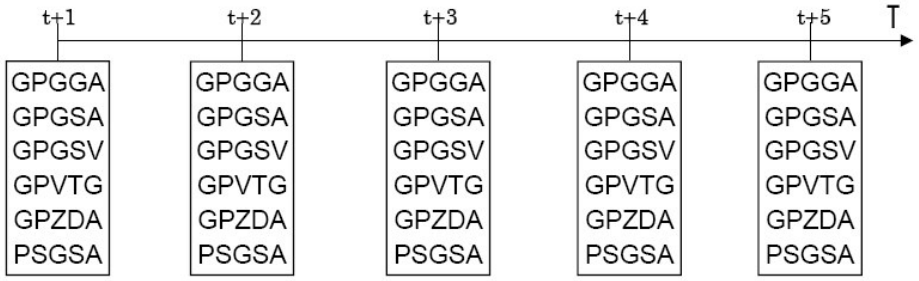
$GPGSV,2,1,08,28,52,298,49,31,34,097,42,04,00,242,27,20,55,152,47*7E

$GPGSV,2,2,08,14,,,00,11,63,033,49,07,,,00,08,15,239,37*7B

$GPVTG,152.1,T,,M,000.0,N,000.0,K,A*0A

$GPZDA,105512,12,11,2003,,*48

$PSGSA,4,11,20,28,31,08,,,,,,,,03.2,01.7,02.7,01685,10551110,H*22



Single message example(at 4800 bps)

$GPGGA,112350,3536.6006,N,13944.8931,E,1,08,00.9,00098.1,M,039.2,M,,*44

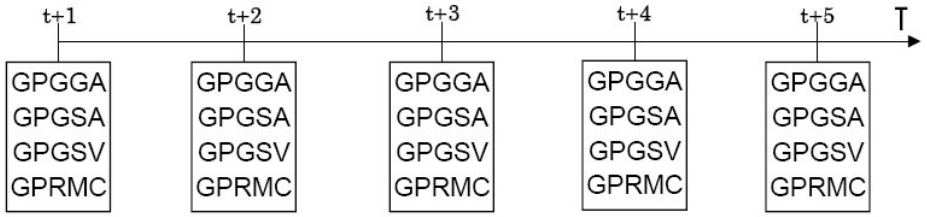
$GPGSA,A,3,09,10,17,18,21,26,28,29,,,,,02.1,00.9,01.8*00

$GPGSV,3,1,11,05,02,178,00,08,03,039,00,09,52,208,46,10,34,120,43*77

$GPGSV,3,2,11,15,09,322,26,17,20,175,41,18,28,313,38,21,43,283,48*78

$GPGSV,3,3,11,26,59,023,50,28,18,063,39,29,50,044,45,,,,*46

$GPRMC,112350,A,3536.6006,N,13944.8931,E,000.0,016.2,240304,,,A*7B



3.1.1 GPGGA sentence

- Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPGGA		GGA header
UTC of position	012041		hh: Hours mm: Minutes ss: Seconds
Latitude	3537.1464		dd: ° mm.mmmm: ′*1
North/South	N		N: North Latitude, S: South Latitude
Longitude	13943.8529		Ddd: ° mm.mmmm: ′*1
East/West	E		E: East Longitude, W: West Longitude *1
GPS Quality Indicator	2		0: Disabled, 1: GPS positioning, 2: D-GPS positioning
Number of satellites	07		Number of satellites used in positioning calculation (00 to 12)
HDOP	01.2		*2
Altitude	00101.2	meters	*3
Unit	M		Meters
Geoidal separation	039.2	meters	*4

Unit	M		Meters
Age of DGPS data	04	second	Time elapsed since D-GPS reception*5
DGPS reference station ID	0000		
checksum	42		
<CR><LF>			End of sentence

- Example

$GPGGA,012041,3537.1464,N,13943.8529,E,2,07,01.2,00101.2,M,039.2,M,04,0000*42

- Note

*1 The Longitude is always expressed as 0 degree when the Latitude is 90 degree, and is expressed as Longitude 0(180) degree East when the Longitude is 0(180) degree West.

*2 The DOP value is expressed as two integer digits and one decimal digit. Values 99.9 and higher are expressed as 99.9.

*3 The elevation is expressed as five integer digits and one decimal digit. Values of 99999.9 or more (–99999.9 or less) are expressed as 99999.9 (–99999.9).

*4 The difference from the geoidal surface is expressed as three integer digits and one decimal digit.

*5 The DGPS Age is expressed as two integer digits.

3.1.2 GPGLL sentence

- Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPGLL		GLL header
Latitude	3537.1483		dd: ° mm.mmmm: ′
North/South	N		N: North Latitude, S: South Latitude
Longitude	13943.8511		ddd: ° mm.mmmm: ′*1
East/West	E		E: East Longitude, W: West Longitude *1
UTC of position	034639		hh: Hours mm: Minutes ss: Seconds
Status	A		A: Data valid, V: Data invalid
Mode Indicator	A		A: Autonomous, D: D-GPS, N: Data not valid *2
checksum	41		
<CR><LF>			End of sentence

- Example

$GPGLL,3537.1483,N,13943.8511,E,034639,A,A*41

- Note

*1 The Longitude is always expressed as 0 degree when the Latitude is 90 degree, and is expressed as Longitude 0(180) degree East when the Longitude is 0(180) degree West.

*2 Position system mode indicator

3.1.3 GPGSA sentence

- Explanation

Contents	Example	Explanation
Sentence ID	$GPGSA	GSA header
Mode	A	M: Manual, A: Automatic
Positioning mode	3	1: Fix not available, 2: 2D, 3: 3D
Satellite ID number	05	ID number of satellite used in solution
Satellite ID number	06	ID number of satellite used in solution
…		Display of quantity used (12 max)
PDOP	01.6	*
HDOP	01.0	*
VDOP	01.3	*
checksum	05	
<CR><LF>		End of sentence

- Example

$GPGSA,A,3,05,06,09,14,18,23,25,30,,,,,01.6,01.0,01.3*05

- Note

* The DOP value is expressed as two integer digits and one decimal digit. Values 99.9 and higher are expressed as 99.9.

3.1.4 GPGSV sentence

- Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPGSV		GSV header
Total number of sentences	2		Total number of GSV sentences output (1 to 9) *1
Sentence number	1		Sequence number within total number (1 to 9)
Total number of satellites in view	08		Number of satellites visible from receiver
Satellite ID number	05		Satellite ID (01 to 32) *2
Elevation	61	degrees	Elevation angle of satellite as seen from receiver (00 to 90)
Azimuth	056	degrees	Satellite azimuth as seen from receiver (000 to 359)
SNR (C/N)	35	dBHz	Received signal level C/N (00 to 99) *3
…			
Satellite ID number	14		Write for four satellites
Elevation	52	degrees	
Azimuth	321	degrees	
SNR (C/N)	42	dBHz	
checksum	70		
<CR><LF>			End of sentence

- Example

$GPGSV,2,1,08,05,61,056,35,06,12,158,41,09,23,066,41,14,52,321,42*70

- Note

*1 For 4800 bps, the maximum output lines are 3 lines.

*2 It is outputted in order of Satellite ID number.

*3 “00” when not tracking

3.1.5 GPRMC sentence

- Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPRMC		RMC header
UTC of position	093931		hh: Hours mm: Minutes ss: Seconds
Status	A		A: Data valid, V: Data invalid
Latitude	3536.5987		dd: ° mm.mmmm: ′
North/South	N		N: North Latitude, S: South Latitude
Longitude	13944.8905		ddd: ° mm.mmmm: ′*1
East/West	E		E: East Longitude, W: West Longitude *1
Speed over ground	000.0	knots	Receiver’s speed *2
Course over ground	090.7	degrees	Receiver’s direction of travel Moving clockwise starting at due north
Date	241203		dd: Day, mm: Month, yy: Year
Magnetic variation		degrees	*3
East/West			E: East, W: West *3
Mode Indicator	A		A: Autonomous, D: D-GPS, N: Data not valid *4
checksum			76
<CR><LF>			End of sentence

- Example

$GPRMC,093931,A,3536.5987,N,13944.8905,E,000.0,090.7,241203,,,A*76

- Note

*1 The Longitude is always expressed as 0 degree when the Latitude is 90 degree, and is expressed as Longitude 0(180) degree East when the Longitude is 0(180) degree West.

*2 The Speed over ground is expressed as three integer digits and one decimal digit. Values 999.9 and higher are expressed as 999.9.

*3 Travel direction (Degree Magnetic) is not output.

*4 Positioning system mode indicator

3.1.6 GPVTG sentence

- Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPVTG		VTG header
Course over ground	275.6	degrees	Receiver's direction of travel Moving clockwise starting at due north
	T		
Course over ground		degrees	Receiver's direction of travel*1
	M		
Speed over ground	000.0	knots	Receiver's speed (knots) *2
Unit	N		knots
Speed over ground	000.0	km/h	Receiver's speed (km/h) *2
Unit	K		km/h
Mode Indicator	A		A: Autonomous, D: D-GPS, N: Data not valid *3
checksum	0B		
<CR><LF>			End of sentence

- Example

$GPVTG,275.6,T,,M,000.0,N,000.0,K,A*0B

- Note

*1 Travel direction (Magnetic Degrees) is not output.

*2 The Speed over ground is expressed as three integer digits and one decimal digit. Values 999.9 and higher are expressed as 999.9.

*3 Positioning system mode indicator

3.1.7 GPZDA sentence

- Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPZDA		ZDA header
UTC	105512		UTC time
Day	12		Day according to UTC time
Month	11		Month according to UTC time
Year	2003		Year according to UTC time
Local zone hours		hour	*
Local zone minutes		minute	*
checksum	48		
<CR><LF>			End of sentence

- Example

$GPZDA,105512,12,11,2003,,*48

- Note

* Local zone hours and Local zone minutes are not output.

3.1.8 PSGSA sentence

- Explanation

Contents	Example	Unit	Explanation
Sentence ID	$PSGSA		PSGSA header
Positioning mode	4		See table
Calculation satellite ID	11		Satellite ID number used in speed calculation
Calculation satellite ID	23		Satellite ID number used in speed calculation
…			Display quantity of satellite used (12 max)
PDOP	01.5		Speed calculation PDOP *1
HDOP	00.9		Speed calculation HDOP *1
VDOP	01.2		Speed calculation VDOP *1
TCXO offset value	01682	Hz	*2
Positioning calculation time	10270708		hhmmssxx hh:Hours mm: Minutes ss:seconds xx:0.01seconds Time determined in positioning calculation
SONY Reserve	D		Reserved
checksum	29		
<CR><LF>			End of message

Value	Explanation
0	Speed non-positioning
1	2D speed positioning
2	Pseudo 3D speed positioning
3	3D speed positioning

- Example

$PSGSA,4,11,23,27,03,08,28,20,31,,,,,01.5,00.9,01.2,01682,10270708,D*29

- Note

*1 The DOP value is expressed as two integer digits and one decimal digit. Values 99.9 and higher are expressed as 99.9.

*2 The TCXO offset value is expressed as five integer digits. Values 99999(-99999) and higher(lower) expressed as 99999(-99999).

3.2 NMEA Message Data Output Specifications

The following table describes the output data configurations in the following positioning states: immediately after cold start, during positioning, during non-positioning and after positioning.

3.2.1 GPGGA sentence

Contents	After cold start	During positioning	During non-positioning
UTC of position	default (00:00:00)	UTC	UTC
Latitude	null	Positioning results	Previous value
North/South	N	Positioning results	Previous value

Longitude	null	Positioning results	Previous value
East/West	E	Positioning results	Previous value
GPS Quality Indicator	0	1 or 2	0
Number of satellites	00	Positioning results	00
HDOP	null	Positioning results	null*
Altitude	null	Positioning results	Previous value
Geoidal separation	null	Positioning results	Previous value
Age of DGPS data	null	null/DGPS information	null/DGPS information
DGPS reference station ID	null	null/DGPS information	null/DGPS information

* Non-positioning results are based on DOP limit restrictions. So, the DOP value is displayed.

3.2.2 GPGLL sentence

Contents	After cold start	During positioning	During non-positioning
Latitude	null	Positioning results	Previous value
North/South	N	Positioning results	Previous value
Longitude	null	Positioning results	Previous value
East/West	E	Positioning results	Previous value
UTC of position	default (00:00:00)	UTC	UTC
Status	V	A	V
Mode Indicator	N	A or D	N

3.2.3 GPGSA sentence

Contents	After cold start	During positioning	During non-positioning
Mode	A	A	A
Positioning mode	1	2 or 3	1
Satellite ID number	null	Positioning results	null
PDOP	null	Positioning results	null*
HDOP	null	Positioning results	null*
VDOP	null	Positioning results	null*

*Non-positioning results are based on DOP limit restrictions. So, the DOP value is displayed.

3.2.4 GPGSV sentence

Contents	After cold start	During positioning	During non-positioning
Total number of sentences	1	Calculation results	Calculation results
Sentence number	1	Calculation results	Calculation results
Number of satellites in view	00	Calculation results	Calculation results
Satellite ID	null	Calculation results	Calculation results
Elevation	null	Calculation results	Calculation results
Azimuth	null	Calculation results	Calculation results
SNR(C/N)	null	Calculation results	Calculation results

3.2.5 GPRMC sentence

Contents	After cold start	During positioning	During non-positioning

UTC of position	default (00:00:00)	UTC	UTC
Status	V	A	V
Latitude	null	Positioning results	Previous value
North/South	N	Positioning results	Previous value
Longitude	null	Positioning results	Previous value
East/West	E	Positioning results	Previous value
Speed over ground	null	Positioning results	Previous value
Course over ground	null	Positioning results	Previous value
Date	default (010303)	UTC	UTC
Magnetic	null	null	null
East /West	null	null	null
Mode Indicator	N	A or D	N

3.2.6 GPVTG sentence

Contents	After cold start	During positioning	During non-positioning
Course (True)	null	Positioning results	Previous value
Course (Magnetic)	null	null	null
Speed (knot)	null	Positioning results	Previous value
Speed (km/h)	null	Positioning results	Previous value
Mode Indicator	N	A or D	N

3.2.7 GPZDA sentence

Contents	After cold start	During positioning	During non-positioning
UTC	default (00:00:00)	UTC	UTC
Day	default (01)	UTC	UTC
Month	default (03)	UTC	UTC
Year	default (2003)	UTC	UTC
Local zone hours	null	null	null
Local zone minutes	null	null	null

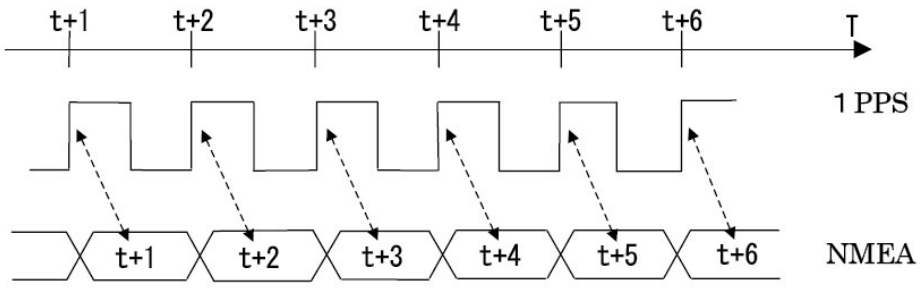
3.2.8 PSGSA message

Contents	After cold start	During positioning	During non-positioning
Positioning mode	0	1 or 2 or 3	0
Calculation satellite ID	null	Positioning results	null
PDOP	Calculation results	Positioning results	null*
HDOP	Calculation results	Positioning results	null*
VDOP	Calculation results	Positioning results	null*
TCXO offset value	00000	Positioning results	Previous value

* During non-positioning based on DOP limit restrictions, the DOP value is displayed.

3.3 NMEA Message Output Timing

NMEA messages are output within 1 s after the 1PPS pulse as shown in figure below.


t+1
t+2
t+3
t+4
t+5
t+6
T
1 PPS
t+1
t+2
t+3
t+4
t+5
t+6
NMEA

4 Options Summary

The following options could be achieved by mounting different components on board. Once it is mounted, it is also fixed. These options are open to users for more market opportunity.

Items	Default	Options	Remark
Baud rate	4800	9600,19200,38400	Bps
WAAS	off	on	Available only after F/W R22
Power switch	no	High enable	Cut off VCC power supply
GPS status LED	no	Green LED	GPS positioning status
6-pin connector	no	2.54 mm male	Connector interface